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(54) PLASTICS MOLDING METHOD AND APPARATUS AND PLASTICS ARTICLE OBTAINED THEREBY

(71) We, THE PLASTIC FORMING COMPANY, INC., a corporation organized and existing under the laws of the State of Connecticut, United States of America, of Box 3626, Woodbridge, Connecticut 06525, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates generally to the plastics molding art, and more specifically to a new and useful method of and apparatus for molding hollow articles of thermoplastic material. While not limited thereto, this invention is particularly concerned with the blow molding of such articles.

In the blow molding art the plastics material is usually heated and shaped either intermittently or continuously, to a tubular form commonly referred to as a parison. A portion of the parison is trapped between a pair of mold sections and air under pressure is introduced into the parison, by a blowpipe or by a needle, causing it to expand and conform with the mold faces.

While this technique works very well for many purposes, it does pose certain problems. When forming a double wall container part, for example, approximately one half of the trapped parison portion billows into the female mold cavity and becomes the outer wall while the other half of the trapped parison portion drapes over the male mold part and becomes the inner wall. The further these parison portions are stretched by blowing the thinner they become. In the cavity portion, the thinnest areas will be at the corners. This is undesirable because these will be the outside corners of the finished part which should be thick for product durability. To compensate for this, either a greater initial thickness of material must be provided, with accompanying increase in weight and cost, or the cavity depth must be restricted and the corners rounded, imposing a design limitation.

When the inner wall of such double wall part is compartmented, the male mold part will be recessed to form the compartment-defining ribs. Here again, as the trapped parison portion is expanded into such recesses it is thinned out and weakened. To avoid this, such ribs must be designed either broad or shallow, imposing another design limitation.

Another design limitation resides in the practical impossibility of locating reinforcements or other inserts between the inner and outer walls when blow molding with a parison. Also, only a single material, and colour, are available in a given parison.

In addition, the movable piercing needle customarily used to introduce pressure fluid of necessity has a restricted opening and the flow restriction presented thereby lengthens the time required to fill the part to blowing pressure. This can cause poor surface texture definition because of cooling of the plastics material during the time required to reach blowing pressure.

According to the present invention, there is provided a method of forming a hollow article of thermoplastic material which comprises the steps of

(i) positioning a first sheet of heated thermoplastic material betwen a first mold section and a first face of an intermediate mold plate;

(ii) positioning a second sheet of heated thermoplastic material between a second mold section and a second face of the intermediate mold plate;

(iii) effecting relative motion between respectively each mold section and the corresponding face of the intermediate mold plate to effect engagement between each mold section and its corresponding intermediate mold plate face whereby to for a mold cavity between each mold section and its corresponding mold plate face with said first and second sheets extending into the mold cavities so formed;

(iv) applying a fluid pressure differential causing said first and second sheets to conform to the configurations of the mold surfaces of said first and second mold sections respectively;

(v) effecting relative motion between each mold section and its corresponding intermediate mold plate face to effect disengagement of the mold sections, carrying said first and second sheets, from the plate; and

(vi) thereafter closing said first and second mold sections against each other to cause said first and second sheets to join together and thus complete the forming of said hollow article.

The invention further provides apparatus for forming hollow articles of thermoplastics material, said apparatus comprising:

a pair of mold sections and an intermediate mold plate, each mold section being engageable against a separate face of said intermediate mold plate by relative motion between the section and the plate;

means for positioning heat softened plastics material in sheet form between each mold section and its associated face of the mold plate when said sections are disengaged from the mold plate;

means for effecting relative motion between each mold section and the intermediate mold plate to effect engagement between each mold section and associated face of the mold plate to form a mold cavity with the sheet plastics material extended into said cavity;

means for producing a fluid pressure differential against each sheet to cause each sheet to conform with the configurations of the mold face of its respective mold section, to form a segment of the hollow article;

means for effecting relative motion between each mold section and the intermediate mold plate to effect disengagement of each mold section from the mold plate and to remove said mold plate from between said mold sections; and

means for thereafter closing said mold sections against each other to join the formed segments.

Preferably, the intermediate mold plate is so designed as to urge at least a portion of at least one of the sheets towards the corresponding mold section during the engagemen of the mold sections with the intermediate mold plate. The intermediate mold plate may thus be regarded as performing a preforming function in that it causes some preliminary shaping of the sheet material prior to the final shaping effected by the application of the fluid pressure differential.

By means of the invention, inserts may be positioned between the formed sheets, thus enabling, where reinforcing inserts are emloyed, the utilisation of thinner material with consequent reduction in weight without sacrificing strength. Alternatively or additionally the insert may be a heat insulating member.

The invention is now described in great r detail with reference to one embodiment thereof and with the aid of the accompanying drawings in which:—

Figures 1, 2, 3 and 4 schematically illustrate the method and apparatus of this invention at different point in the molding cycle;

Figure 5 is a fragmentary sectional view similar to that of Figure 2 but on an enlarged scale and schematically illustrating the apparatus in greater detail;

Figure 6 is a fragmentary view, on the same enlarged scale; illustrating a molded article produced by the apparatus of Figure 5;

Figure 7 is a view in side elevation, illustrating a molding apparatus of this invention;

Figure 8 is a view thereof in end elevation, taken about on line 8—8 of Figure 7, and also showing the retracted position of the apparatus and of the preforming frame in broken lines;

Figures 9, 10, 11 and 12 are transverse sectional views taken about on lines 9—9, 10—10, 11—11 and 12—12, respectively, of Figure 7, with parts omitted for clarity in illustration;

Figure 13 is a fragmentary detailed sectional view of the mold throw control mechanism, taken about on line 13—13 of Figure 10; and

Figure 14 is a view like that of Figure 13, but showing the control mechanism in its alternative position.

Whereas conventional blow molding techniques generally use a tubular parison of thermoplastic material, a segment of which is trapped between mating mold members and expanded into surface conformance with such mating mold members by blowing, the present invention is free of the various design limitations imposed by such techniques. This is clearly illustrated by reference to Figures 1—4 which schematically illustrate the invention and from which it is seen that the heated thermoplastic material is presented to the mold, not in the form of a tubular parison, but instead in the form of separate sheets 1 and 2. Also, it will be seen that, in addition to the usual mold halves comprising a male mold part 3 and female mold part 4, there is provided a further mold part 5 which is designated herein for convenience, as an intermediate mold plate. In the embodiment illustrated, this intermediate plate performs a preforming function as mentioned hereinbefore and is therefore referred to hereinafter as a preforming plate frame. This plate frame, in its operative position, is interposed between the male and female mold members.

In Figures 1—4, a blown plastics article of body or lid of a container, is formed. To this hollow, double-wall construction, such as a end, male mold member 3 has a face 6 against which sheet 1 is blown to form the

inner wall of the article, while female mold member 4 has a face 7 against which sheet 2 is blown to form the outer wall of the article. Mold members 3 and 4 can be conventional per se and it will be noted that the face 6 of male member 3 is recessed at 8 to provide a rib or embossment 9 on the inner wall of the article.

Conventionally, sheets 1 and 2 would not be separate but would comprise two portions of a tubular parison of continuous side wall form and the mold members 3 and 4 would close against each other whereupon the plastics material would be blown against the surfaces 6 and 7. In doing this, the plastics material would stretch unevenly and would be thinned out particularly at the corners 10 of the cavity and the inner or bottom surface of the recess 8. As previously pointed out, this is undesirable because it imposes design limitations on rib 9, and because the outer walls of the article must be thicker than otherwise required in order to provide the desired thickness of material at the stretched out corners.

All of this is avoided by the present invention because the plastics material is presented in the form of separate sheets, which are preferably provided in continuous manner by extrusion, permitting the interposition of preforming frame 5, and because these separate sheets of material are independently molded, each with the aid and assistance of the preforming frame operating in conjunction with the associated mold half.

Thus, as clearly illustrated by Figure 2, in accordance with our invention, the male and female mold members close initially, not against each other, but instead against the preforming frame 5. As they close a projecting face 11 which generally conforms to surface 7 of female mold member 4 engages and pushes the material of sheet 2 ahead of it, towards the corners 10. Preforming frame 5 also has a projection 12 which enters recess 8 of male mold member 3 and which engages and pushes the material of sheet 1 into recess 8 as the male mold member closes against the preforming frame. The plastics material of sheet sections 1 and 2 in contact with the projections 11, 12 of the preforming frame does not stretch significantly, and the projections 11, 12 are arranged to carry the plastics material into close proximity with the corners 10 and the inner surface of recess 8.

When the mold members 3, 4 are closed against the forming frame 5, air or other fluid under pressure is introduced through the forming frame, as illustrated in Fig. 5, to blow the sheets 1 and 2 into exact conformity with the surface defining faces 6 and 7 of mold members 3 and 4. Such thinning out as may occur when the material is blown into corners 10 and against the inner surface of recess 8 is relatively insignificant and can easily be controlled through proper design of the preforming frame projections.

After the sheet sections have thus been separately and independently formed against their respective mold members, the mold is opened and forming frame 5 is removed, as shown in Fig. 3 which also shows that the formed sheet material adheres to the male or female mold members as they are opened. Then, as the final step, the male and female mold members are closed, this time against each other, sealing the plastics material of the respective mold members together along a line defined by the mold edges 13 and 14, as shown in Fig. 4. Once again, air or other fluid is introduced under pressure, as by a needle, holding the sheet material against the mold surfaces as cooling is completed.

During the molding of the separate sheets on the first closing of the mold as illustrated in Fig. 2, the sheet material is held against the mold surfaces 6 and 7 by fluid pressure long enough to form the sheet material and to cool it to the point where it will not move when the mold is reopened to remove the preforming frame 5. At the same time, the inside of the sheet material adjacent mold edges 13 and 14 must be kept hot enough to cause this material to weld together when the mold is reclosed without the preforming frame, as illustrated in Fig. 4. To accomplish this, the preforming frame 5 can carry insulating member 15 which engage those portions of the plastics material which must be kept hot. If necessary, members 15 can be heated. Also, to avoid unnecessary squeezing and cooling of the plastics material in the areas to be subsequently welded, stop members 16 can be provided, for example on preforming frame 5 and cavity 16 to limit the closing movement of the mold halves relative to the preforming frame.

Thus, it is seen that the molding technique of this invention possesses the important advantage of mechanically preforming the plastics material to avoid undesired stretching and consequently thinning thereof. Also, sheets 1 and 2 can be of different plastics materals, or of different thickness and can be of different colors, offering freedom in these respects beyond anything possible with conventional blow molding techniques.

Fig. 5 shows the male and female mold members and preforming frame in greater detail, and in a position between that of Figs. 1 and 2. For ease of understanding, corresponding parts in Fig. 5 have the same numbers as in Figs. 1—4 but primed so as to distinguish between the respective showings.

Referring now to Fig. 5, male member

3¹ carries a spring loaded frame 17 which is guided by pins 18 and urged by springs 19 into engagement with preforming frame 5¹, so as to yieldably clamp sheet 1¹ between male member 3¹ and frame 5¹ as they approach one another, in advance of full closing thereof. Similarly, a clamping frame 20 is carried by forming frame 5¹, being guided by pins 21 and urged by springs 22 into engagement with female member 4¹, to yieldably grip sheet 2 prior to full closing of female member 4¹ and forming frame 5¹. The degree of closing required before clamping frames 17 and 20 engage the plastics sheets can be varied, and while such clamping before full closing often will not be necessary, it provides a measure of control over the stretching of the plastics material and also provides an air seal when it is desired to control stretching or cooling by blowing prior to full closing.

Forming plugs 11¹ are carried by frame 5¹ to engage and carry sheet material 2¹ toward the corners 10¹, and a forming plug 12¹ is carried by frame 5 to engage and carry sheet material 1¹ into recess 8¹ in male member 3¹. Insulated or heated sections 15¹ engage the sheet material in the areas to be subsequently welded, and manifold air passages 23 having multiple outlets 24 are provided in forming frame 5¹, being adapted for communication with any suitable source of supply. It will be observed, from Fig. 5, that a very large volume of pressure fluid can be introduced very rapidly as distinguished from the volume and rapidity of introduction of pressure fluid through a conventional blowing system. This offers the opportunity for better surface texture on the blown plastics article, because it can be blown again the mold surface sooner, before it has cooled to an extent precluding full texture conformance.

In this respect, the method and apparatus of this invention offer a further advantage in placement of the needle for final blowing when the mold sections close against each other (Fig. 4). This is clearly shown in Fig. 5 wherein a fixed needle 76 is carried by mold section 3¹. Needle 76 communicates with a source of pressure fluid through passages 75, and, unlike the usual blow needle, can be relatively short and have a relatively large diameter opening. If sheets 1¹ and 2¹ were portions of a tubular parison, the former would merely drape over needle 76. However, with our invention a sleeve 77 concentric with needle 76 is carried by preforming frame 5¹ and pushes sheet 1¹ against needle 76, causing the needle to pierce the sheet whereby the needle is positioned for final blowing. While the needle is shown piercing the plastics in Fig. 5, this will not occur until just before closing of mold section 3¹ against preforming frame 5¹.

It is believed that the cooling of the formed plastics prior to opening the mold sections will suffice to retain these sections in their respective mold halves. Vacuum can be used, if desired, to help hold the blown plastics sections in the mold, through vacuum passages 25. Alternatively, a mechanical interlock can be provided by forming either both of the mold halves with an undercut ledge, as illustrated by way of example at 26. Also, it will be observed from Figs. 5 and 6 that the male and female mold parts 3 and 4 can be designed so that when the mold is reclosed, a lap weld as shown at 27 is achieved instead of a butt weld.

Another advantage offered by the present invention is the ability to position the inner and out rewalls of the finished articles very close together without bridging or webbing. This is very difficult when blow molding a tubular parison, because the wall sections come into close proximity with each other during closing of the mold, while the material of said wall sections is still very hot and tacky. If the two wall sections touch during this closing, they will tend to stick together, causing an undesirable webbing condition or causing a blow-out when blowing pressure is applied. With the present invention, on the other hand, the inner and outer walls are compeltely formed separately from one another, without opportunity to web or bridge. The positioning thereof in close juxtaposition occurs only after the individual forming. At this time it is possible to minimize clearance between walls, or to bring the two walls into weldable contact at certain points to provide reinforcement.

Another important advantage provided by the present invention and not possible with conventional blow molding techniques is the ability to position an insert such as shown at 28 (Fig. 6) between the inner and outer wall sections. Such insert can be carried by a support 29 on frame 5¹ which positions the insert against the inner surface of either wall section as the latter is formed, whereby the insert will be positioned between the wall sections upon reclosing the mold. The insert 28 can be loosely supported on bracket 29, and can be either self adhering or otherwise brought into contact with the plastics sheet material during the forming of the latter. For example, suitable ejetcion mechanism, not shown, can be provided.

Also, if portions of the finished article are to be removed, for example to provide access between the walls of a double wall container part, such cut out portions can be prescored by a die member carried by frame 5¹ and pinching the material against the mold section, thereby eliminating the need for routing out such material from the molded article.

Referring to Figs. 7—14, the mold parts 3

pinned to rod 39¹ which moves therewith. It will be appreciated that, for ease of illustra- with bearing blocks 31 engaging guide rails 32 for movement between the extended position shown in full lines in Fig. 8 and a retracted position indicated in broken lines in Fig. 8, the motive power being furnished by a pneumatic drive cylinder 33 anchored to the underside of carrier 30 by the supporting base 37 on which guide rails 32 are mounted and which forms the base support for the entire assembly. When retracted, drive cylinder 33 moves carrier 30 to the full line position in Fig. 8 to receive the plastics sheet material, which as indicated, can be extruded vertically downwardly along that axis from any suitable extruding means, not shown. Extension of drive cylinder 33 moves carrier 30 out of the way to its retracted position illustrated in broken lines in Fig. 8.

An upper guide rod 37¹ is journalled in suitable bushings 38 at opposite sides of carrier frame 30. A pair of lower guide rods 39, 39¹ are journalled in bushings 40, also positioned at opposite sides of carrier frame 30. Rods 37¹ and 39 are drive rods. The other rod 39¹ is interrupted, to permit swinging passage of preforming frame 5 as will be described, and comprises axially aligned spaced apart rod lengths 39¹, 39¹¹ as will become apparent.

Preforming frame 5 has a mounting extension 41 journalled on rod 37¹ for pivoting between the positions shown in Fig. 8, being confined between a pair of brackets 42 through which rod 37¹ freely passes, and frame 5 is swung between these positions, in the manner of a pendulum, by drive means which conveniently comprise a pneumatic cylinder 43 pivotally anchored at 44 to a bracket 45 which is mounted on one side of carrier 30 by a bracket 46. Cylnider 43 has a piston rod 47 pivotally connected at 48 to frame 5 at a point offset from the frame pivot axis as defined by rod 37¹ whereby extension of cylnider 43 positions frame 5 between mold halves 3 and 4, as shown in full lines in Figs. 7 and 8, and retraction of cylinder 43 swings frame 5 out of the way, to the broken line position of Fig. 8, permitting the mold halves to close against each other as depicted in Fig. 4. An adjustable stop, shown as a bolt 49 threaded in a bracket 50 on carrier 30 but more typically in hydraulic cushion functions to stop frame 5 in its proper position between mold section 3 and 4, for preforming.

Mold section 4 is mounted on a platen 51 having at three of its corners ears 52 which receive and are pinned to rods 37¹¹, 39 and 39¹¹, as shown at 53. Similarly, mold section 3 is carried by a platen 54 having at three of its corners ears 55, but in this case the ears slidably receive the rods 37¹, 39 for movement relative thereto, while being and 4, and the preforming frame 5 are mounted on a carrier frame 30 which is provided tion, mold sections 3 and 4 are shown only schematically in Figs. 7 and 12.

Mold sections 3 and 4 are moved between opened and closed positions by drive means including a pneumatic cylinder 56 carried by carrier frame 30 and having, at the outer end of its piston rod 57, a crosshead 58 held against horizontal movement (as viewed in Fig. 7) and guided in its vertical reciprocation by a guide bracket 59 mounted on frame 30. A pair of toggle members 60, 61 are pivotally secured at their adjacent ends to cross head 58. The remote end of toggle member 61 is formed to provide a clevis which carries a pin 62 movable therewith along longitudinal guide slots 63 provided in guide bracket 64 on opposite sides of frame 54. The remote end of toggle member 60 is similarly formed to provide a clevis which carries a pin 65 movable therewith along longitudinal guide groove or slots 66 provided in bracket 67 on a yoke 68 having ear like extensions 69 and 70 which receive rods 37¹ and 39 and are pinned thereto, as indicated at 70¹. In the illustrated form toggle pins 62 and 65 are journalled in the clevis ends of members 60 and 61, and have flat-sided ends which slide in grooves 63 and 66, but other toggle pin and guide arrangements can be used.

Thus, it will be seen that extension of crosshead 58 to the position shown in full lines in Fig. 7 causes toggle member 61 to shift frame 54 and mold sections 3 to the left, while causing member 60 to shift yoke 68 and, through rods 37¹ and 39 simultaneously shifts frame 51 and mold section 4 to the right as viewed in Fig. 7, thereby opening the mold sections. Conversely, retraction of crosshead 58 to the broken line position thereof in Fig. 7 extends the toggle mechanism, shifting frame 54 and mold section 3 to the right while shifting yoke 68 and with it rods 37¹ and 39, frame 51 and mold section 4 to the left, thereby closing the mold sections.

The toggle mechanism must alternately close the mold sections against forming frame 5 and against each other. To accomplish this, an interrupted lost motion connection is provided between toggle members 60 and 61, and their respective brackets 64, 67. This is clearly illustrated in Figs. 13 and 14, which show pin 65 of toggle member 60 movable along groove 66 between yoke 68, defining a stop at one end of the groove and a stop member 71 carried by bracket 67 and defining a stop at the opposite end of groove 66. With crosshead 58 extended, toggle member 60 is at the inner end of its path of travel, against stop 71 and the same arrangement will exist with respect to toggle member 61 and bracket 64. When the mold

sections are intended to close against each other, a motion limiting block 72 carried by the piston rod 73 of a pneumatic cylinder 74 is shifted into positon behind pin 65, and a like arrangement and action occurs with respect to toggle 61. In this position of blocks 72, upon retraction of crosshead 58 the pins 62, 65 of toggle members 60, 61 will be held against relative sliding motion, causing mold sections 3 and 4 to travel a greater distance and close against each other, to the position illustrated in Fig. 4 and in broken lines in Fig. 7. Upon opening the mold sections, cylinders 74 will be actuated to retract blocks 72, whereupon retraction of crosshead 58 will cause toggle member 60 and 61 to move initially relative to yoke 68 and frame 54 and thereupon move mold sections 3 and 4 toward each other through a lesser distance to close instead against frame 5. Thus, the two motion limiting blocks 72 at opposite ends of the toggle mechanism have a combinde thickness equal to the corresponding dimension of frame 5 in terms of mold opening and closing, and by alternately retracting and extending them out of and into blocking position relative to pins 62 and 65 the mold sections are caused to close first against frame 5 and then against each other.

While only the blocking mechanism for pin 65 is shown in Figures 13 and 14, that for pin 62 is identical in construction and operation.

Appropriate timing mechanism may be provided for the operation of the apparatus. Also, where required, appropriate means, not illustrated, may be provided to sever the extruded plastics material trapped between the mold sections and the interposing framing plate.

Accordingly, it will be seen that this invention provides a method of and apparatus for blow molding which offers the ability to preform mechanically, to use sections of plastics material of different composition, thickness and color in the same molding cycle, and to blow mold a hollow, double wall article having reinforcing or other inserts between the walls thereof.

WHAT WE CLAIM IS:—

1. A method of forming a hollow article of thermoplastic material which comprises the steps of

(i) positioning a first sheet of heated thermoplastic material betwen a first mold section and a first face of an intermediate mold plate;

(ii) positioning a second sheet of heated thermoplastic material between a second mold section and a second face of the intermediate mold plate;

(iii) effecting relative motion between respectively each mold section and the corresponding face of the intermediate mold plate to effect engagement between each mold section and its corresponding intermediate mold plate face whereby to for a mold cavity between each mold section and its corresponding mold plate face with said first and second sheets extending into the mold cavities so formed;

(iv) applying a fluid pressure differential causing said first and second sheets to conform to the configurations of the mold surfaces of said first and second mold sections respectively;

(v) effecting relative motion between each mold section and its corresponding intermediate mold plate face to effect disengagement of the mold sections, carrying said first and second sheets, from the plate; and

(vi) thereafter closing said first and second mold sections against each other to cause said first and second sheets to join together and thus complete the forming of said hollow article.

2. A method as claimed in claim 1 in which during step (iii) at least a portion of at least one of said sheets is urged towards the mold surface of the corresponding mold section by a surface of the intermediate mold plate.

3. A method as claimed in claim 1 or claim 2 wherein after conforming with the configurations of the mold surfaces of said mold sections, said sheets are caused or allowed to cool sufficiently to adhere to said mold sections when said sections are parted from said intermediate mold plate.

4. A method as claimed in any one of claims 1 to 3 wherein said sheets are joined together by welding.

5. A method as claimed in any one of claims 1 to 4 wherein the sheets are positioned on opposite sides of the intermediate mold plate.

6. A method as claimed in any one of claims 1 to 5 in which an insert is positioned between the sheets prior to closing the mold sections against each other.

7. A method as claimed in claim 6, in which the insert is positioned against one of said sheets during engagement of the associated one of said mold sections with the corresponding face of said intermediate mold plate.

8. A method as claimed in any one of claims 1 to 7 in which said sheets are continuously formed by extrusion.

9. A method as claimed in any one of claims 1 to 8 in which the fluid pressure differential is applied by introducing pressure fluid between each sheet and the intermediate plate.

10. A method as claimed in any one of

claims 1 to 9 in which during the molding of the hollow article one of said sheets is forced against a needle carried by the associated one of said mold sections so as to be penetrated thereby.

11. A method according to claim 1 of forming a hollow plastic article, substantially as hereinbefore described and as illustrated with reference to the accompanying drawings.

12. Apparatus for forming hollow articles of thermoplastics material, said apparatus comprising:

a pair of mold sections and an intermediate mold plate, each mold section being engageable against a separate face of said intermediate mold plate by relative motion between the section and the plate;

means for positioning heat softened plastics material in sheet form between each mold section and its associated face of the mold plate when said sections are disengaged from the mold plate;

means for effecting relative motion between each mold section and the intermediate mold plate to effect engagement between each mold section and associated face of the mold plate to form a mold cavity with the sheet plastics material extended into said cavity;

means for producing a fluid pressure differential against each sheet to cause each sheet to conform with the configurations of the mold face of its respective mold section, to form a segment of the hollow article;

means for effecting relative motion between each mold section and the intermediate mold plate to effect disengagement of each mold section from the mold plate and to remove said mold plate from between said mold sections; and

means for thereafter closing said mold sections against each other to join the formed segments.

13. Apparatus as claimed in claim 12 further including means on the intermediate mold plate for positioning an insert against one of said segments as the latter is formed.

14. Apparatus as claimed in claim 12 or claim 13, further including means for maintaining the portions of said segments to be jonied sufficiently warm to permit such joining while the remaining portions thereof cool sufficiently to remain in said mold sections during disengagement thereof from the intermediate mold plate and removal of said plate from therebetween.

15. Apparatus as claimed in any one of claims 12 to 14, further including a hollow needle carried by one of said mold sections, said hollow needle being adapted for connection to fluid pressure supply means and to project from the mold face.

16. Apparatus as claimed in any one of claims 12 to 15 including yieldable clamping means adapted to engage the plastics sheet material between each mold section and the associated face of the intermediate mold plate prior to completion of engagement of the mold sections with the mold plate.

17. Apparatus as set forth in any one of claims 12 to 16 wherein said fluid pressure differential producing means includes fluid conduit means in said intermediate mold plate, and means for introducing fluid through said fluid conduit means against said sheet material for expanding the same against said mold sections.

18. Apparatus as claimed in claim 12 for forming hollow articles of plastics material, substantially as hereinbefore described and as illustrated in the accompanying drawings.

19. A hollow plastics article of double wall construction formed by the process of any one of claims 1 to 11 and comprising a first wall member having a peripheral edge portion and formed from a first sheet of thermoplastic material and a second wall member also having a peripheral edge portion and formed from a second sheet of thermoplastic material, said peripheral edge portions being bonded together.

20. An article as claimed in claim 19 wherein the peripheral edge portions overlap.

21. A hollow plastics article as claimed in claim 19 or claim 20 in which said first wall member comprises an outer shell having a base wall surrounded by a side wall portion leading to the peripheral edge portion thereof, and asid second wall member comprises an inner shell also having a base portion surrounded by side wall portions leading to the peripheral edge portion thereof, and said article also includes an insert member located between side wall portions of said inner and outer shells.

22. An article as claimed in claim 21, wherein said insert is a reinforcing member.

23. An article as claimed in claim 21, wherein said insert is a heat insulating member.

24. A hollow plastics article as claimed in claim 19, substantially as hereinbefore described and illustrated in the accompanying drawings.

25. A hollow plastics article obtained using the apparatus of any of claims 12 to 18.

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Sheet 1

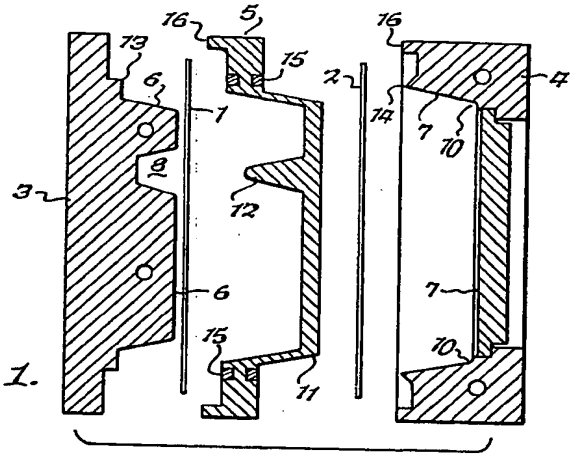

Fig. 1.

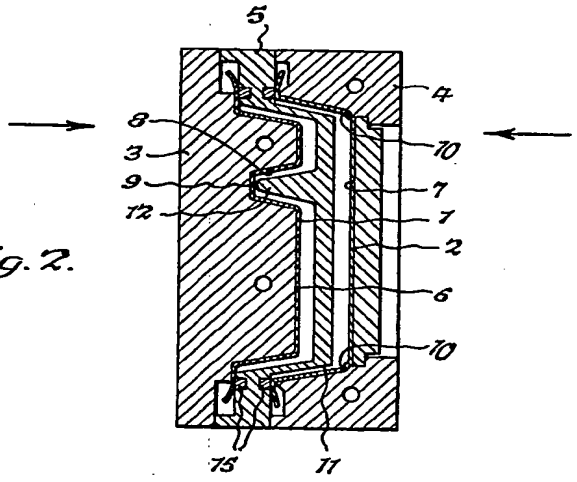

Fig. 2.

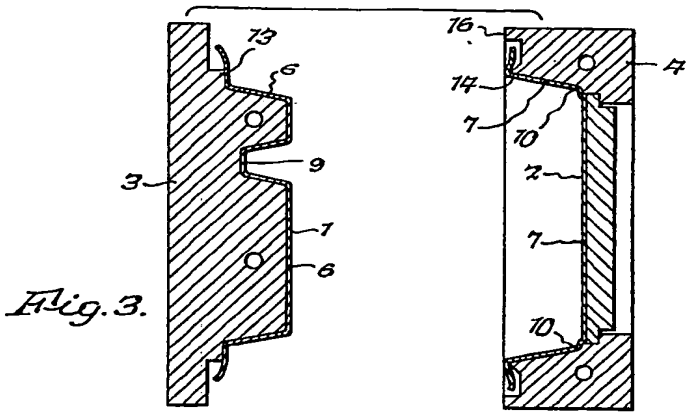

Fig. 3.

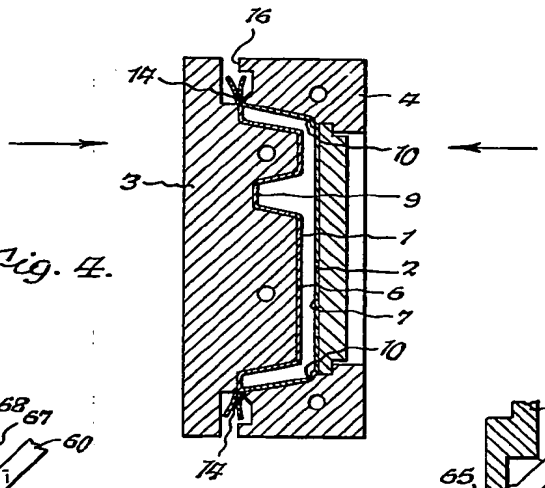

Fig. 4.

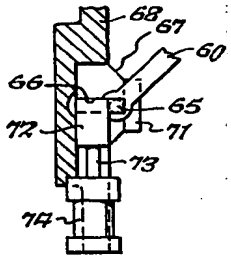

Fig. 13.

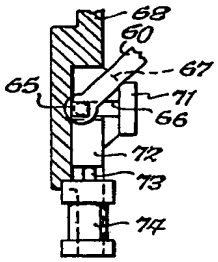

Fig. 14.

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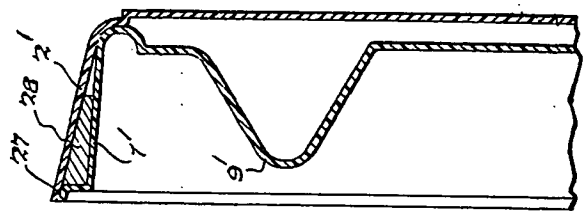
Sheet 3

Fig. 6.



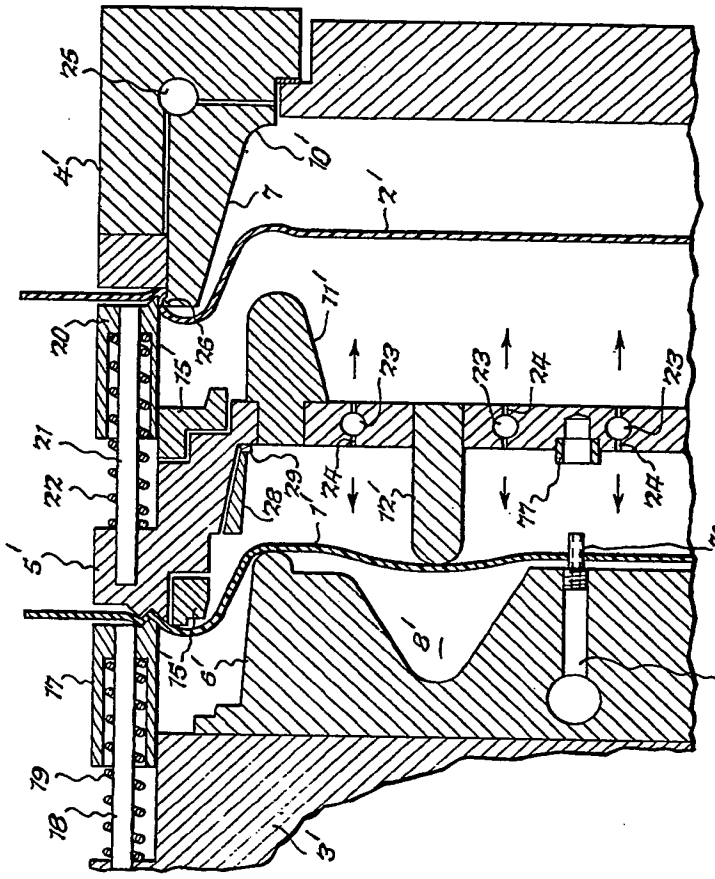


Fig. 5.

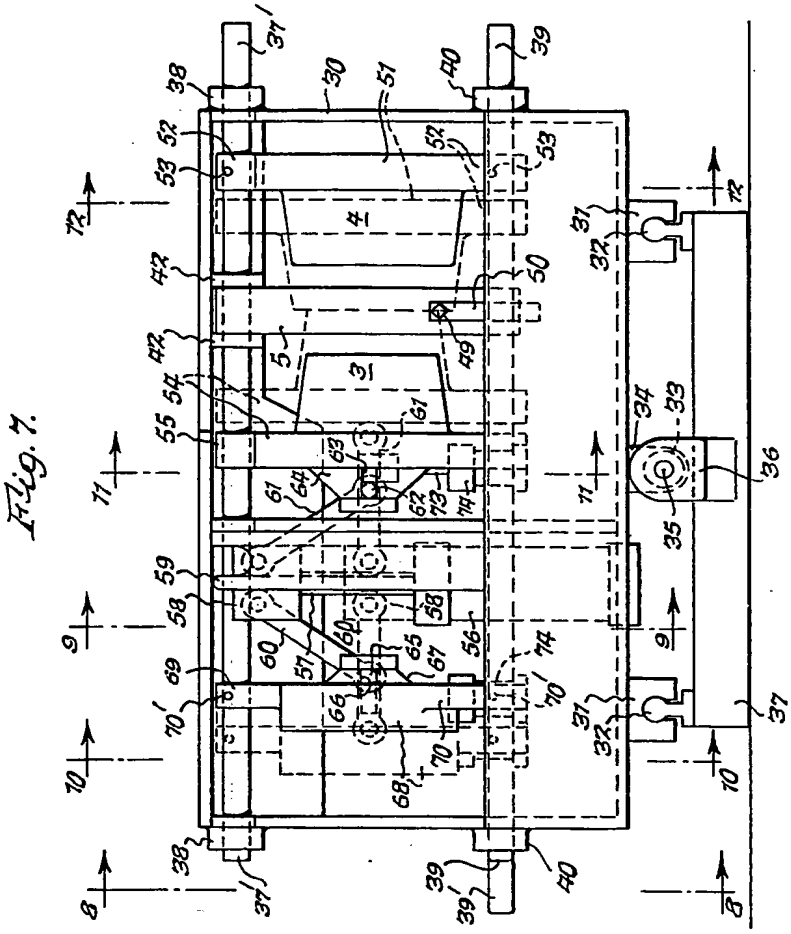
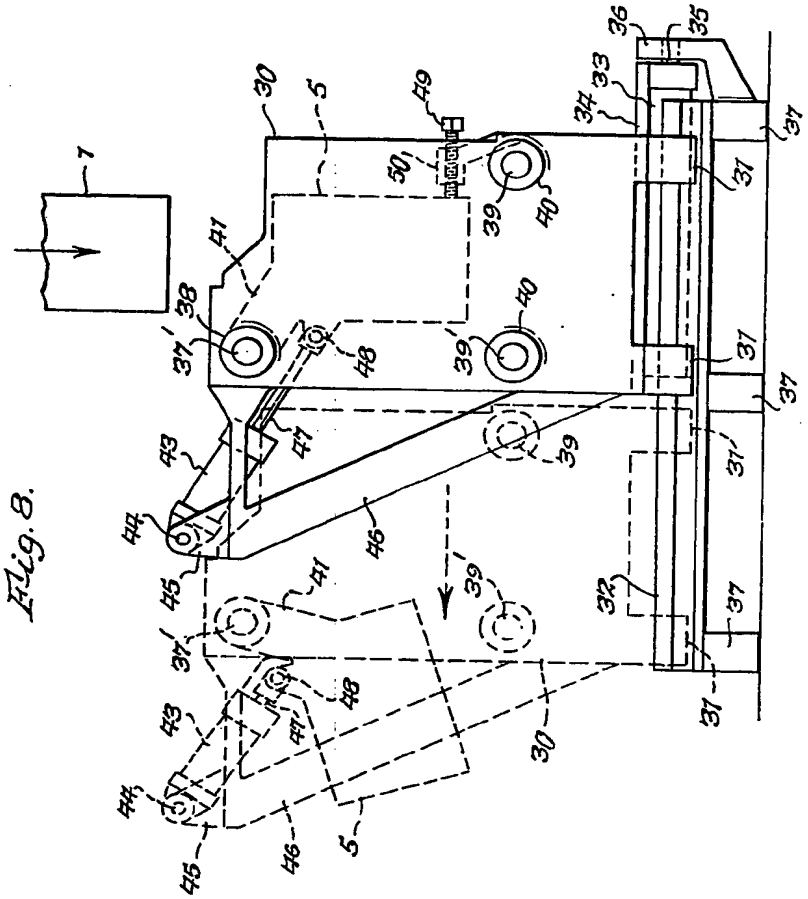


Fig. 1.

1410215 COMPLETE SPECIFICATION
6 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 5



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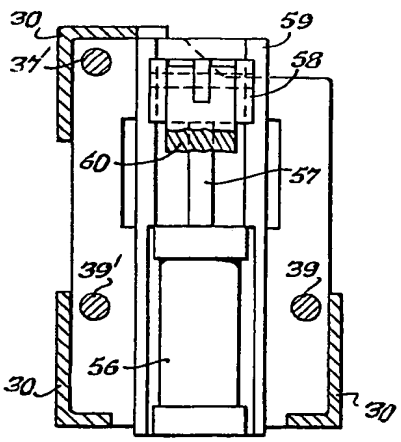

Fig. 9.

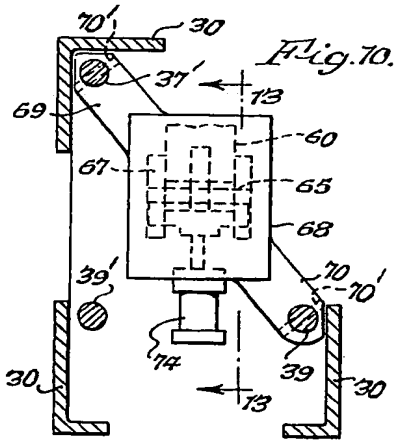

Fig. 10.

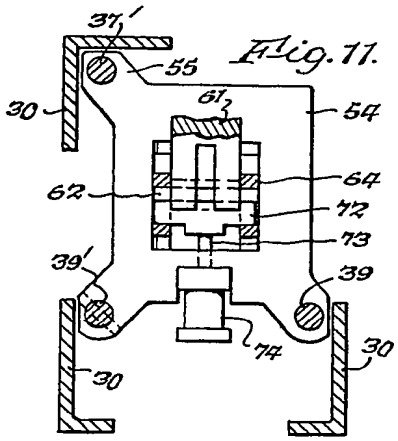

Fig. 11.

Fig. 12.